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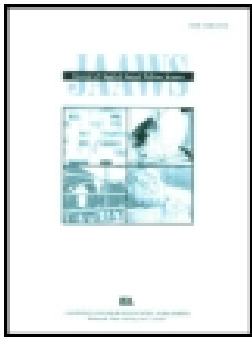
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Animal Welfare Worldwide, the Opinion of Practicing Veterinarians

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ABSTRACT

The objective of this study was to investigate the animal welfare issues considered the most important by companion animal veterinarians worldwide. For this purpose, a global survey of several potential animal welfare issues was distributed via SurveyMonkey® in multiple languages. The distribution of survey responses differed by region. The main animal welfare concern reported worldwide was obesity, although there were differences across regions, possibly due to cultural and socioeconomic factors. Anthropomorphism (attributing human qualities or characteristics to an animal) was an issue in western countries but less so in Asia, Africa, and Oceania. There were significant differences between Asia and Europe, Africa, and Oceania in the importance and prevalence of convenience euthanasia. There were also age and sex differences in participant responses, with older veterinarians reporting fewer welfare problems than younger veterinarians, and female veterinarians reporting more welfare issues than their male counterparts.



KEYWORDS


Animal welfare; geographic regions; global; veterinarians

Introduction

Veterinarians are expected to have expertise not only in the maintenance of health and the treatment and prevention of disease in animals, but also in matters relating to the welfare of the animals in their immediate care and beyond (Siegford, Cottee, & Widowski, 2010). The World Organization for Animal Health (OIE) states that veterinarians “*should be the leading advocates for the welfare of all animals*” (OIE, 2012), and the Federation of Veterinarians of Europe (FVE), the American Veterinary Medical Association (AVMA), and the Canadian Veterinary Medical Association (CVMA) have jointly declared that “*veterinarians are, and must continually strive to be, the leading advocates for the good welfare of animals in a continually evolving society*” (AVMA, 2014).

Professional and societal expectations require veterinarians to be leaders in promoting animal welfare, and to make informed medical and ethical choices regarding their animal patients. Veterinary choices may depend on a variety of factors including local legislative requirements, drug and equipment availability, and cultural expectations. An appreciation of the role of the

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companion animal practitioner is necessary in order to improve the welfare of companion animals, mainly dogs and cats,¹ around the world. Although many owners of companion animals have a strong bond with their animals, devoting time and money to their welfare, hereditary diseases (Hendricks, 1992), obesity (Chandler et al., 2017), and abuse (Munro & Thrusfield, 2001) remain major welfare problems.

Issues surrounding animal welfare have become of increasing importance to veterinarians, governments, and society worldwide. How veterinarians view and experience various animal welfare issues may differ as a result of geographic, cultural, socioeconomic, and other factors. To identify those animal welfare issues perceived as the most important by veterinarians, a global survey was developed by the WSAVA's Animal Welfare Guidelines Group (AWGG) (see Appendix). The aim of this study was to compare the attitude of veterinarians and allied professionals to 20 animal welfare-related subjects.

Materials and methods

Development of questions

The survey questions were developed by the AWGG to assess various issues that may impact companion animal welfare. The AWGG consists of veterinarians with private practices, veterinary specialists in animal welfare and a clinical psychologist. The survey was divided into three parts. The first part consisted of five questions regarding the respondent's personal information, i.e. gender, age, place of practice, the country and institute where they obtained their veterinary degree, and whether they were currently a veterinary practitioner.

The second part consisted of twenty Likert-style questions, scored 1–5 (1 = very important, 2 = important, 3 = variable importance, 4 = not very important, and 5 = not important). Respondents also had the opportunity to provide additional information, e.g. what their most important animal welfare-related issues were if not included in the list.

The welfare issues addressed were:

- **Incorrect or inappropriate nutrition** – inappropriate feeding can seriously impact on animal welfare. Overfeeding may lead to obesity; underfeeding and/or inappropriate feeding may cause hunger, nutritional deficiencies, and possibly retarded development.
- **Genetic or breed-related issues** – these cover all welfare-related issues that may exist because of genetic and congenital disorders/diseases.
- **Lack of routine prophylaxis** – lack of routine vaccinations and/or other prophylactic treatments may allow otherwise preventable diseases to adversely affect health and welfare.
- **Obesity** – increased body weight may predispose to a variety of health issues, such as diabetes, etc.
- **Age-related issues** – aging predisposes to the development of cognitive impairment, osteoarthritis, degenerative diseases, etc.
- **Aggression** – directed toward humans or other animals may limit pleasant social interaction between animal and owner, reducing welfare and increasing the likelihood of relinquishment.
- **Separation-related behavior** – animals that are overly dependent on human company may experience anxiety when owners are absent.
- **Lack of socialization** – a lack of socialization may result in an animal that is less able to interact appropriately with other animals or humans, leading to stress and diminished welfare.
- **Disobedience** – a “*disobedient*” animal will not endear itself to its owner and may result in corrective measures adversely affecting welfare.
- **Inappropriate elimination** – or “*soiling*” may be due to physical or behavioral reasons. The decrease in welfare is owner related, as the treatment of and relationship with the animal may change if the soiling continues.

- **Delay or refusal to euthanize** – preservation of life without quality, without adequate palliative relief is detrimental to an animal's welfare.
- **Lack of knowledge** – there are many ways that a lack of knowledge of owners can adversely affect animal welfare.
- **Animal abuse** – mistreatment of animals adversely affects animal welfare.
- **Noncompliance** – a failure of owners to follow advice or the prescribed veterinary treatment may have a negative effect on an animal's welfare, mostly health related.
- **Anthropomorphism** – while companion animals are usually the recipients of affection from their owners, often regarded as being part of the family, it should not be forgotten that they are not human. Treating animals like humans may result in a multitude of welfare problems, including animal aggression, disobedience, obesity, and a refusal to euthanize when truly necessary.
- **Confinement/lack of exercise** – confinement will lead to, amongst other issues, a lack of opportunity to exercise and express natural behaviors.
- **Refusal to treat** – If treatment is refused or not sought, the animal's welfare will suffer.
- **Treatment by non-qualified persons** – treatment by unlicensed “*alternatives*” to veterinarians, such as para-veterinarians, breeders or other “*experts*” may negatively affect animal welfare. Incorrect diagnoses or treatments may cause suffering or death.
- **Convenience euthanasia** – a situation where an owner decides that the animal is no longer wanted.
- **Uncontrolled or over-breeding** – Unwanted nests or stray animals put pressure on available resources, reducing the quality of life of animals. Commercial animal breeders (“*puppy farms*”) may use animals predisposed to congenital defects, which increases the likelihood that the offspring develop welfare-damaging health issues later in life.

The third section of the survey asked respondents about their knowledge/education on the following subjects: dentistry, animal behavior, surgical techniques, client communication, animal welfare and zoonotic disease, and their ability to remain up to date on these subjects.

The survey was available in English, French, Chinese, Spanish and Russian, and distributed through SurveyMonkey® in 2016 (available at URL: <https://www.surveymonkey.com/>; see **Appendix**). The target audience consisted of companion animal veterinarians worldwide, who can choose which language version of the survey they prefer. The survey was advertised on the website of WSAVA (<https://www.wsava.org/>) and regional contacts of WSAVA were asked to publish the link to the survey on their regional veterinary website. Furthermore, respondents were recruited using the snowball method through Facebook, WSAVA's website (<https://www.facebook.com/WSAVA>).

Statistical analysis

To allow for representative sampling, the respondents were divided into six geographic regions: Europe (including Russian Federation), Asia, North America, South America, Africa and Oceania. All statistical analyzes were carried out using IBM® SPSS® Statistics for Windows (version 24.0) computer program (IBM Corp., Armonk, NY, USA) and according to Field (2009). Two-sided probabilities were estimated throughout. The ordinal (Likert type) data from the survey are presented as scores (i.e. number of respondents) with in parentheses the relative frequency (%) in tables. In figures these data are presented as stacked bar charts. The hypothesis that the probabilities of choosing the Likert-scale categories of the questions were the same for the various groups (six geographic regions, two genders, four or five educational backgrounds) was tested using the Likelihood ratio test (G-test of goodness-of-fit). *Post hoc* comparisons for these Likert-type data were performed also with the Likelihood ratio test. Spearman coefficient of rank correlation (R_s) was calculated for the Likert-scale categories of the questions and age of the respondents; this was done both worldwide and per geographic region. Significance was assessed with a two-tailed test based on

the t statistic. Although there are no hard and fast rules for describing correlational strength, the following guidelines are widely accepted: $0 \leq |R_s| < 0.3$, weak correlation; $0.3 \leq |R_s| < 0.7$, *moderate* correlation; and $0.7 \leq |R_s| \leq 1.0$, **strong** correlation.

In addition, the data from the Likert scale questions 6–9 of the survey (see supplementary Appendix) were also analyzed by the program Categorical Principal Component Analysis (CATPCA), version 2.0; the software that is part of IBM® SPSS® Statistics for Windows (version 24.0) (Linting & Van der Kooij, 2012). Through the use of CATPCA, clusters of related welfare issues could be identified within the questionnaire. A four components model was chosen, since there were four questions in the survey including the 20 animal welfare issues. All extracted components had an eigenvalue ≥ 2 . A variable principal normalization method was used. The rotated solution was extracted by using the varimax rotation (with Kaiser normalization) of the component matrix. This method ensures that the extracted components are independent of one another and should, therefore, reflect separate processes. The varimax algorithm was chosen, because it attempts to minimize the number of variables that have high loadings on a component, which should improve interpretability. The rotated component loading of each welfare issue indicated how well that issue correlated with the component; thus a loading of ± 1.0 indicates a perfect (positive/negative) correlation, whereas an absolute loading of less than 0.4 would suggest that the question is rather weakly linked to the component. A Cronbach's alpha score was calculated for each of the four components to determine the internal consistency. The advisable cutoff point used for Cronbach's alpha was 0.7 or above for good internal consistency.

To account for the greater probability of a Type I error due to multiplicity (multiple comparisons and/or multiple questions) a more stringent criterion was used for statistical significance (i.e. for the Likelihood ratio tests). A so-called Dunn-Šidák correction ($\alpha = 1 - [1 - 0.05]^{1/\gamma}$) was calculated; comparing six geographic regions, comparing five veterinary institutions, or comparing four veterinary institutions: $\gamma = \text{number of questions} = 20 \rightarrow \alpha = 0.002561$; comparing two genders: $\gamma = \text{number of questions} = 20 \rightarrow \alpha = 0.002561$; comparing two geographic regions: $\gamma = \text{number of questions multiplied by the number of comparisons} = 20 \times 15 = 300 \rightarrow \alpha = 0.000171$; comparing two out of five veterinary institutions: $\gamma = \text{number of questions multiplied by the number of comparisons} = 20 \times 10 = 200 \rightarrow \alpha = 0.000256$; comparing two out of four veterinary institutions: $\gamma = \text{number of questions multiplied by the number of comparisons} = 20 \times 6 = 120 \rightarrow \alpha = 0.000427$.

Calculating numerous correlations also increases the risk of a Type I error. To avoid this, the level of statistical significance of the Spearman correlation coefficients (R_s) were adjusted, using the Dunn-Šidák method ($\alpha = 1 - [1 - 0.05]^{1/\kappa}$; $\kappa = \text{total number of questions} = 20 \rightarrow \alpha = 0.002561$).

Statistical significance represented by P values may not necessarily confirm practical importance. In our opinion, the size of the observed effects is perhaps more important than statistical significance. Effect sizes (w) reported for the contingency tables were derived from Cramer's V using the formula:

$$w = V \times \sqrt{(r - 1)}$$

where w = effect size w , V = Cramer's V , and r = the number of rows or columns (whichever is the smaller of the two). The following standard cutoffs for w were used (Cohen, 1988): zero or nearly zero effect, $0 \leq w < 0.1$; *small* effect, $0.1 \leq w < 0.3$; **moderate** effect, $0.3 \leq w < 0.5$; and **large** effect, $w \geq 0.5$.

Results

Demographics

Overall, 1167 surveys from in total 73 different countries were returned, 1014 of which were complete. Table 1 shows the number of respondents per geographic region, country and gender. One male respondent answered all the questions but did not specify where he came from. The 152 respondents

Table 1. Number of respondents (veterinary practitioners and associated professions) per geographical region, country and gender.

Geographical region		
• Country	Number of respondents (Males/Females)	Number of respondents with completely filled survey (Males/Females)
Europe	431 (115/316) (26.8%/73.3%)	376 (94/282) (25.0%/75.0%)
• Russian Federation	208 (57/151)	189 (46/143)
• Netherlands	71 (11/60)	64 (8/56)
• United Kingdom of Great Britain and Northern Ireland	59 (11/48)	40 (8/32)
• Spain	31 (9/22)	28 (9/19)
• Ukraine	19 (11/8)	18 (10/8)
• Estonia	8 (1/7)	7 (1/6)
• Greece	8 (4/4)	7 (3/4)
• Belgium	3 (2/1)	3 (2/1)
• Norway	4 (1/3)	3 (1/2)
• Slovenia	3 (0/3)	3 (0/3)
• Germany	3 (1/2)	2 (0/2)
• Luxembourg	2 (0/2)	2 (0/2)
• Slovakia	2 (1/1)	2 (1/1)
• Albania	1 (1/0)	1 (1/0)
• Austria	1 (1/0)	1 (1/0)
• Croatia	1 (1/0)	1 (1/0)
• Denmark	1 (0/1)	1 (0/1)
• Ireland	1 (1/0)	1 (1/0)
• Latvia	1 (0/1)	1 (0/1)
• Poland	1 (1/0)	1 (1/0)
• Switzerland	1 (0/1)	1 (0/1)
• Portugal	1 (1/0)	0 (0/0)
• Sweden	1 (0/1)	0 (0/0)
Asia	385 (164/221) (42.6%/57.4%)	330 (139/191) (42.1%/57.9%)
• Israel	166 (71/95)	141 (57/84)
• China (People's Republic of)	70 (35/35)	56 (29/27)
• Singapore	39 (10/29)	35 (10/25)
• Malaysia	33 (14/19)	32 (14/18)
• Indonesia	22 (11/11)	19 (9/10)
• Vietnam	18 (5/13)	15 (4/11)
• Philippines	11 (2/9)	10 (2/8)
• Sri Lanka	7 (1/6)	6 (1/5)
• India	3 (3/0)	3 (3/0)
• Cyprus	2 (2/0)	2 (2/0)
• Iran (Islamic Republic of)	2 (2/0)	2 (2/0)
• Thailand	2 (0/2)	1 (0/1)

(Continued)

Table 1. (Continued).

Geographical region		
• Country	Number of respondents (Males/Females)	Number of respondents with completely filled survey (Males/Females)
• Azerbaijan	1 (1/0)	1 (1/0)
• Bahrain	1 (1/0)	1 (1/0)
• Cambodia	1 (1/0)	1 (1/0)
• Mongolia	1 (0/1)	1 (0/1)
• Myanmar	1 (0/1)	1 (0/1)
• Nepal	1 (1/0)	1 (1/0)
• Taiwan	1 (1/0)	1 (1/0)
• Uzbekistan	1 (1/0)	1 (1/0)
• Georgia	1 (1/0)	0 (0/0)
• Japan	1 (1/0)	0 (0/0)
North America	94 (29/65) (30.9%/69.1%)	81 (24/57) (29.6%/70.4%)
• United States of America	58 (19/39)	50 (15/35)
• Canada	30 (8/22)	25 (7/18)
• Jamaica	3 (1/2)	3 (1/2)
• Belize	1 (0/1)	1 (0/1)
• Mexico	1 (0/1)	1 (0/1)
• Saint Kitts and Nevis	1 (1/0)	1 (1/0)
South America	32 (16/16) (50.0%/50.0%)	26 (14/12) (53.8%/46.2%)
• Argentina	14 (6/8)	12 (5/7)
• Colombia	5 (3/2)	4 (3/1)
• Ecuador	5 (3/2)	4 (2/2)
• Chili	3 (1/2)	2 (1/1)
• Venezuela (Bolivarian Republic of)	2 (1/1)	2 (1/1)
• Brazil	2 (1/1)	1 (1/0)
• Nicaragua	1 (1/0)	1 (1/0)
Africa	60 (42/18) (70.0%/30.0%)	49 (35/14) (71.4%/28.6%)
• South Africa	28 (13/15)	25 (12/13)
• United Republic of Tanzania	9 (9/0)	8 (8/0)
• Mali	8 (5/3)	4 (3/1)
• Nigeria	3 (3/0)	2 (2/0)
• Zambia	3 (3/0)	2 (2/0)
• Sudan	2 (2/0)	2 (2/0)
• Tunisia	2 (2/0)	2 (2/0)
• Mauritania	1 (1/0)	1 (1/0)
• Morocco	1 (1/0)	1 (1/0)
• Namibia	1 (1/0)	1 (1/0)
• Niger	1 (1/0)	1 (1/0)
• Djibouti	1 (1/0)	0 (0/0)

(Continued)

Table 1. (Continued).

Geographical region	Number of respondents (Males/Females)	Number of respondents with completely filled survey (Males/Females)
• Country		
Oceania	164 (56/108) (34.1%/65.9%)	152 (53/99) (34.9%/65.1%)
• Australia	149 (50/99)	138 (47/91)
• New Zealand	14 (5/9)	13 (5/8)
• Fiji	1 (1/0)	1 (1/0)
Unknown	1 (1/0)	0 (0/0)
Total	1167 (422/744) (36.2%/63.8%)	1014 (359/655) (35.4%/64.6%)
Veterinary practitioners and associated professions		1015
• Non-practitioners		136
✓ Non-veterinarians		39
✓ Veterinarians		97
• Veterinary practitioners		879

who only filled out their names were not included in any of the analyses. Of the 1015 respondents for whom gender was known, 360 were male and 655 were females, 136 were non-practitioners, and 879 were practitioners. The non-practitioners were mainly active in industry, academia, or government. The practicing veterinarians were mainly companion animal practitioners.

CATPCA

The results for the CATPCA on the 20 welfare issues are summarized in Table 2. The five welfare issues from the category “*Potential behavioral-related issues*” loaded all high (0.588–0.754) on Component 2. With the exception of “confinement/lack of exercise” (Component 3, loading value: 0.406) the welfare issues of category “*Social related issues*” loaded high on Component 1 (loading values: 0.723–0.751). The welfare issues of the categories “*Animal health related issues*” and “*Owner-related issues*” loaded high on three components (i.e. Components 1, 3 and 4). The loading values ranged from 0.405 to 0.772. According to the accepted interpretation of Cronbach’s alpha, these scores indicated good internal consistency for all of the components (Cronbach’s alpha: 0.786–0.860).

Regional differences

There were significant ($P < 0.002561$) regional differences on almost all animal welfare issues (*small/moderate* effects: effect size w ranged from 0.210 to 0.385), except for incorrect or inappropriate nutrition ($P = 0.087192$; *small* effect, $w = 0.166$), aggression ($P = 0.018238$; *small* effect, $w = 0.196$), lack of socialization ($P = 0.006291$; *small* effect, $w = 0.195$), delay or refusal to euthanize ($P = 0.002699$; *small* effect, $w = 0.237$), and noncompliance ($P = 0.028213$; *small* effect, $w = 0.213$) (Table 3).

The results for the six geographic regions, as well as the worldwide results are also illustrated by means of figures. The ones for which the effect size is *moderate* in the six geographic regions comparison (genetic or breed-related issues, obesity, age-related issues, anthropomorphism, confinement/lack of exercise, and convenience euthanasia) are presented as stacked bars in Figure 1 (panels A–F). The remaining welfare issues are given as supplementary figures (Figure S1, panels A–N).

Table 2. Rotated component loadings from a four-dimensional CATPCA on 20 animal welfare issues with all variables analyzed ordinally.^a

Type of issue • Welfare issues	Components			
	Comp. 1 (0.860) ^b	Comp. 2 (0.842)	Comp. 3 (0.786)	Comp. 4 (0.820)
<i>Animal health related issues</i>				
• Incorrect or inappropriate nutrition	0.178	0.190	0.140	0.705
• Genetic or breed-related issues	0.195	0.047	0.729	−0.019
• Lack of routine prophylaxis	0.405	0.217	−0.127	0.521
• Obesity	−0.046	0.393	0.653	0.151
• Age-related issues	−0.078	0.304	0.702	0.059
<i>Potential behavioral-related issues</i>				
• Aggression	0.341	0.690	0.162	0.159
• Separation-related behavior	0.026	0.721	0.274	0.151
• Lack of socialization	0.174	0.754	0.052	0.226
• Disobedience	0.098	0.722	0.246	0.031
• Inappropriate elimination	0.338	0.588	0.106	0.108
<i>Owner-related issues</i>				
• Delay or refusal to euthanize	0.561	0.172	0.332	0.066
• Lack of knowledge	0.162	0.084	0.147	0.772
• Animal abuse	0.749	0.275	−0.056	0.275
• Noncompliance	0.313	0.179	0.329	0.535
• Anthropomorphism	0.178	0.067	0.545	0.214
<i>Social-related issues</i>				
• Confinement/lack of exercise	0.329	0.280	0.406	0.328
• Refusal to treat	0.723	0.076	0.185	0.314
• Treatment by non-qualified persons	0.738	0.017	0.009	0.286
• Convenience euthanasia	0.751	0.210	0.169	0.015
• Uncontrolled or over-breeding	0.747	0.160	0.038	0.152

^aThis table is based on questions 6–9 of the questionnaire (see supplementary Appendix) and the scores of 1015 respondents.

^bCronbach's alpha is given in parentheses.

It seems that genetic or breed-related issues (Figure 1, panel A) are less important in Africa than they were in Europe ($P < 0.0000005$; *moderate* effect, $w = 0.422$), Asia ($P = 0.000054$; *moderate* effect, $w = 0.300$), and Oceania ($P = 0.000009$, *moderate* effect, $w = 0.406$). Furthermore, in Europe genetic or breed-related issues are slight, but significantly more important than in Asia ($P = 0.000070$, *small* effect, $w = 0.184$). There were significant differences in the perception of obesity as a welfare issue (Figure 1, panel B). In Africa, obesity was considered less important than it was in Europe ($P < 0.0000005$; *moderate* effect, $w = 0.387$), Asia ($P < 0.0000005$; *moderate* effect, $w = 0.420$), North America ($P = 0.000071$; *moderate* effect, $w = 0.427$), and Oceania ($P < 0.0000005$; *large* effect, $w = 0.522$). Obesity was also significantly more important in Oceania than in South America ($P = 0.000097$; *moderate* effect, $w = 0.410$). Age-related issues (Figure 1, panel C) are less important in Africa when compared with Europe ($P < 0.0000005$; *moderate* effect, $w = 0.426$), Asia ($P < 0.0000005$, *moderate* effect, $w = 0.394$), North America ($P = 0.000002$, *moderate* effect, $w = 0.464$), and Oceania ($P < 0.0000005$, *large* effect, $w = 0.522$). Anthropomorphism (Figure 1, panel D) was considered an animal welfare issue significantly more often in Europe than in Asia ($P = 0.000001$; *small* effect, $w = 0.213$), Africa ($P = 0.000124$;

Table 3. Views of veterinary practitioners and associated professions on animal welfare between the geographic regions of Europe, Asia, North America, South America, Africa and Oceania, as well as worldwide.¹

Welfare issues Likert-scale category		Geographic region						Significance ⁴ /Effect size w) ⁶	
		Overall (1015) ²	Europe (376)	Asia (330)	North America (81)	South America (26)	Africa (49)		Oceania (152)
● Incorrect or inappropriate nutrition									
- Very important		359 (35.4%)	126 (33.5%) ³	123 (37.3%)	35 (43.2%)	11 (42.3%)	15 (30.6%)	49 (32.2%)	(w = 0.166)
- Important		393 (38.7%)	159 (42.3%)	119 (36.1%)	28 (34.6%)	3 (11.5%)	21 (42.9)	63 (41.4%)	
- Variable importance		198 (19.5%)	68 (18.1%)	72 (21.8%)	13 (16.0%)	9 (34.6%)	8 (16.3%)	27 (17.8%)	
- Not very important		49 (4.8%)	17 (4.5%)	10 (3.0%)	3 (3.7%)	2 (7.7%)	5 (10.2%)	12 (7.9%)	
- Not important		16 (1.6%)	6 (1.6%)	6 (1.8%)	2 (2.5%)	1 (3.8%)	0 (0.0%)	1 (0.7%)	
● Genetic or breed-related issues									
- Very important		245 (24.1%)	116 (30.9%) ^{a,5}	61 (18.5%) ^a	16 (19.8%)	6 (23.1%)	6 (12.2%) ^{a,b}	40 (26.3%) ^b	R (w = 0.334)
- Important		441 (43.4%)	170 (45.2%)	145 (43.9%)	36 (44.4%)	8 (30.8%)	15 (30.6%)	67 (44.1%)	
- Variable importance		245 (24.1%)	75 (19.9%)	95 (28.8%)	23 (28.4%)	5 (19.2%)	10 (20.4%)	36 (23.7%)	
- Not very important		69 (6.8%)	14 (3.7%)	24 (7.3%)	4 (4.9%)	7 (26.9%)	12 (24.5%)	8 (5.3%)	
- Not important		15 (1.5%)	1 (0.3%)	5 (1.5%)	2 (2.5%)	0 (0.0%)	6 (12.2%)	1 (0.7%)	
● Lack of routine prophylaxis									
- Very important		354 (34.9%)	95 (25.3%) ^a	143 (43.3%) ^{a,b}	34 (42.0%)	14 (53.8%)	24 (49.0%)	44 (28.9%) ^b	R (w = 0.269)
- Important		362 (35.7%)	158 (42.0%)	119 (36.1%)	28 (34.6%)	2 (7.7%)	10 (20.4%)	45 (29.6%)	
- Variable importance		205 (20.2%)	93 (24.7%)	46 (13.9%)	10 (12.3%)	8 (30.8%)	10 (20.4%)	38 (25.0%)	
- Not very important		71 (7.0%)	20 (5.3%)	15 (4.5%)	7 (8.6%)	2 (7.7%)	4 (8.2%)	22 (14.5%)	
- Not important		23 (2.3%)	10 (2.7%)	7 (2.1%)	2 (2.5%)	0 (0.0%)	1 (2.0%)	3 (2.0%)	
● Obesity									
- Very important		342 (33.7%)	120 (31.9%) ^a	104 (31.5%) ^b	41 (50.6%) ^c	6 (23.1%) ^d	10 (20.4%) ^{a-c,e}	61 (40.1%) ^{d,e}	R (w = 0.381)
- Important		441 (43.4%)	176 (46.8%)	153 (46.4%)	20 (24.7%)	6 (23.1%)	12 (24.5%)	74 (48.7%)	
- Variable importance		175 (17.2%)	63 (16.8%)	61 (18.5%)	15 (18.5%)	12 (46.2%)	9 (18.4%)	14 (9.2%)	
- Not very important		41 (4.0%)	13 (3.5%)	9 (2.7%)	4 (4.9%)	2 (7.7%)	11 (22.4%)	2 (1.3%)	
- Not important		16 (1.6%)	4 (1.1%)	3 (0.9%)	1 (1.2%)	0 (0.0%)	7 (14.3%)	1 (0.7%)	
● Age-related issues									
- Very important		372 (36.7%)	113 (30.1%) ^a	124 (37.6%) ^c	41 (50.6%) ^d	8 (30.8%)	10 (20.4%) ^{a-d}	76 (50.0%) ^b	R (w = 0.385)
- Important		468 (46.1%)	189 (50.3%)	163 (49.4%)	24 (29.6%)	13 (50.0%)	13 (26.5%)	65 (42.8%)	
- Variable importance		134 (13.2%)	67 (17.8%)	31 (9.4%)	14 (17.3%)	4 (15.4%)	11 (22.4%)	7 (4.6%)	
- Not very important		28 (2.8%)	6 (1.6%)	8 (2.4%)	0 (0.0%)	1 (3.8%)	11 (22.4%)	2 (1.3%)	
- Not important		13 (1.3%)	1 (0.3%)	4 (1.2%)	2 (2.5%)	0 (0.0%)	4 (8.2%)	2 (1.3%)	
● Aggression									
- Very important		345 (34.0%)	110 (29.3%)	110 (33.3%)	38 (46.9%)	13 (50.0%)	14 (28.6%)	60 (39.5%)	(w = 0.196)
- Important		341 (33.6%)	124 (33.0%)	128 (38.8%)	21 (25.9%)	5 (19.2%)	14 (28.6%)	49 (32.2%)	
- Variable importance		233 (23.0%)	100 (26.6%)	72 (21.8%)	13 (16.0%)	6 (23.1%)	12 (24.5%)	29 (19.1%)	
- Not very important		83 (8.2%)	38 (10.1%)	16 (4.8%)	8 (9.9%)	2 (7.7%)	6 (12.2%)	13 (8.6%)	
- Not important		13 (1.3%)	4 (1.1%)	4 (1.2%)	1 (1.2%)	0 (0.0%)	3 (6.1%)	1 (0.7%)	

(Continued)

Table 3. (Continued).

Welfare issues <i>Likert-scale category</i>	Overall (1015) ²	Geographic region					Significance ⁴ /(Effect size <i>w</i>) ⁶
		Europe (376)	Asia (330)	North America (81)	South America (26)	Africa (49)	
● Separation-related behavior							
- <i>Very important</i>	193 (19.0%)	48 (12.8%) ^{a-c}	64 (19.4%) ^{a,d}	28 (34.6%) ^b	4 (15.4%)	5 (10.2%) ^{d,e}	44 (28.9%) ^{c,e}
- <i>Important</i>	405 (39.9%)	134 (35.6%)	143 (43.3%)	31 (38.3%)	12 (46.2%)	14 (28.6%)	71 (46.7%)
- <i>Variable importance</i>	290 (28.6%)	130 (34.6%)	96 (29.1%)	12 (14.8%)	7 (26.9%)	14 (28.6%)	30 (19.7%)
- <i>Not very important</i>	103 (10.1%)	53 (14.1%)	22 (6.7%)	7 (8.6%)	3 (11.5%)	12 (24.5%)	6 (3.9%)
- <i>Not important</i>	24 (2.4%)	11 (2.9%)	5 (1.5%)	3 (3.7%)	0 (0.0%)	4 (8.2%)	1 (0.7%)
● Lack of socialization							
- <i>Very important</i>	281 (27.7%)	98 (26.1%)	85 (25.8%)	29 (35.8%)	7 (26.9%)	12 (24.5%)	50 (32.9%)
- <i>Important</i>	392 (38.6%)	122 (32.4%)	146 (44.2%)	35 (43.2%)	13 (50.0%)	24 (49.0%)	52 (34.2%)
- <i>Variable importance</i>	235 (23.2%)	103 (27.4%)	74 (22.4%)	9 (11.1%)	4 (15.4%)	7 (14.3%)	38 (25.0%)
- <i>Not very important</i>	90 (8.9%)	47 (12.5%)	20 (6.1%)	6 (7.4%)	1 (3.8%)	4 (8.2%)	11 (7.2%)
- <i>Not important</i>	17 (1.7%)	6 (1.6%)	5 (1.5%)	2 (2.5%)	1 (3.8%)	2 (4.1%)	1 (0.7%)
● Disobedience							
- <i>Very important</i>	168 (16.6%)	69 (18.4%)	53 (16.1%)	16 (19.8%)	7 (26.9%)	9 (18.4%)	14 (9.2%)
- <i>Important</i>	384 (37.8%)	133 (35.4%)	145 (43.9%)	26 (32.1%)	12 (46.2%)	15 (30.6%)	53 (34.9%)
- <i>Variable importance</i>	334 (32.9%)	125 (33.2%)	104 (31.5%)	26 (32.1%)	7 (26.9%)	14 (28.6%)	58 (38.2%)
- <i>Not very important</i>	100 (9.9%)	41 (10.9%)	23 (7.0%)	6 (7.4%)	0 (0.0%)	7 (14.3%)	22 (14.5%)
- <i>Not important</i>	29 (2.9%)	8 (2.1%)	5 (1.5%)	7 (8.6%)	0 (0.0%)	4 (8.2%)	5 (3.3%)
● Inappropriate elimination							
- <i>Very important</i>	169 (16.7%)	51 (13.6%) ^a	55 (16.7%) ^b	28 (34.6%) ^{a-c}	5 (19.2%)	7 (14.3%)	23 (15.1%) ^c
- <i>Important</i>	376 (37.0%)	139 (37.0%)	135 (40.9%)	28 (34.6%)	10 (38.5%)	13 (26.5%)	51 (33.6%)
- <i>Variable importance</i>	324 (31.9%)	139 (37.0%)	104 (31.5%)	10 (12.3%)	7 (26.9%)	17 (34.7%)	47 (30.9%)
- <i>Not very important</i>	117 (11.5%)	40 (10.6%)	27 (8.2%)	8 (9.9%)	4 (15.4%)	9 (18.4%)	28 (18.4%)
- <i>Not important</i>	29 (2.9%)	7 (1.9%)	9 (2.7%)	7 (8.6%)	0 (0.0%)	3 (6.1%)	3 (2.0%)
● Delay or refusal to euthanize							
- <i>Very important</i>	208 (20.5%)	73 (19.4%)	66 (20.0%)	19 (23.5%)	8 (30.8%)	8 (16.3%)	34 (22.4%)
- <i>Important</i>	363 (35.8%)	148 (39.4%)	120 (36.4%)	22 (27.2%)	8 (30.8%)	9 (18.4%)	55 (36.2%)
- <i>Variable importance</i>	299 (29.5%)	107 (28.5%)	109 (33.0%)	23 (28.4%)	4 (15.4%)	16 (32.7%)	40 (26.3%)
- <i>Not very important</i>	116 (11.4%)	37 (9.8%)	31 (9.4%)	15 (18.5%)	5 (19.2%)	8 (16.3%)	20 (13.2%)
- <i>Not important</i>	29 (2.9%)	11 (2.9%)	4 (1.2%)	2 (2.5%)	1 (3.8%)	8 (16.3%)	3 (2.0%)
● Lack of knowledge							
- <i>Very important</i>	410 (40.4%)	157 (41.8%)	132 (40.0%)	43 (53.1%)	12 (46.2%)	23 (46.9%)	42 (27.6%)
- <i>Important</i>	370 (36.5%)	145 (38.6%)	126 (38.2%)	19 (23.5%)	7 (26.9%)	15 (30.6%)	58 (38.2%)
- <i>Variable importance</i>	196 (19.3%)	56 (14.9%)	65 (19.7%)	15 (18.5%)	4 (15.4%)	10 (20.4%)	46 (30.3%)
- <i>Not very important</i>	33 (3.3%)	16 (4.3%)	6 (1.8%)	3 (3.7%)	1 (3.8%)	1 (2.0%)	6 (3.9%)
- <i>Not important</i>	6 (0.6%)	2 (0.5%)	1 (0.3%)	1 (1.2%)	2 (7.7%)	0 (0.0%)	0 (0.0%)

(Continued)

Table 3. (Continued).

Welfare issues Likert-scale category	Overall (1015) ²	Geographic region						Significance ⁴ /(Effect size w) ⁶
		Europe (376)	Asia (330)	North America (81)	South America (26)	Africa (49)	Oceania (152)	
<ul style="list-style-type: none"> ● Animal abuse - Very important - Important - Variable importance - Not very important - Not important 	417 (41.1%) 192 (18.9%) 165 (16.3%) 183 (18.0%) 58 (5.7%)	127 (33.8%) ^a 85 (22.6%) 69 (18.4%) 73 (19.4%) 22 (5.9%)	172 (52.1%) ^{a,b} 65 (19.7%) 40 (12.1%) 42 (12.7%) 11 (3.3%)	34 (42.0%) 16 (19.8%) 12 (14.8%) 16 (19.8%) 3 (3.7%)	10 (38.5%) 3 (11.5%) 2 (7.7%) 7 (26.9%) 4 (15.4%)	18 (36.7%) 9 (18.4%) 12 (24.5%) 6 (12.2%) 4 (8.2%)	56 (36.8%) ^b 14 (9.2%) 30 (19.7%) 38 (25.0%) 14 (9.2%)	R (w = 0.242)
<ul style="list-style-type: none"> ● Noncompliance - Very important - Important - Variable importance - Not very important - Not important 	323 (31.8%) 401 (39.5%) 229 (22.6%) 51 (5.0%) 11 (1.1%)	116 (30.9%) 157 (41.8%) 79 (21.0%) 21 (5.6%) 3 (0.8%)	116 (35.2%) 126 (38.2%) 77 (23.3%) 9 (2.7%) 2 (0.6%)	31 (38.3%) 30 (37.0%) 15 (18.5%) 5 (6.2%) 0 (0.0%)	5 (19.2%) 6 (23.1%) 9 (34.6%) 4 (15.4%) 2 (7.7%)	12 (24.5%) 17 (34.7%) 13 (26.5%) 4 (8.2%) 3 (6.1%)	43 (28.3%) 65 (42.8%) 35 (23.0%) 8 (5.3%) 1 (0.7%)	(w = 0.213)
<ul style="list-style-type: none"> ● Anthropomorphism - Very important - Important - Variable importance - Not very important - Not important 	200 (19.7%) 387 (38.1%) 283 (27.9%) 117 (11.5%) 28 (2.8%)	112 (29.8%) ^{a-c} 133 (35.4%) 87 (23.1%) 38 (10.1%) 6 (1.6%)	45 (13.6%) ^a 141 (42.7%) 109 (33.0%) 25 (7.6%) 10 (3.0%)	19 (23.5%) 25 (30.9%) 20 (24.7%) 14 (17.3%) 3 (3.7%)	7 (26.9%) 11 (42.3%) 7 (26.9%) 1 (3.8%) 0 (0.0%)	5 (10.2%) ^b 13 (26.5%) 17 (34.7%) 8 (16.3%) 6 (12.2%)	11 (7.2%) ^c 64 (42.1%) 43 (28.3%) 31 (20.4%) 3 (2.0%)	R (w = 0.305)
<ul style="list-style-type: none"> ● Confinement/lack of exercise - Very important - Important - Variable importance - Not very important - Not important 	260 (25.6%) 425 (41.9%) 238 (23.4%) 77 (7.6%) 15 (1.5%)	101 (26.9%) ^{a,b} 156 (41.5%) 96 (25.5%) 19 (5.1%) 4 (1.1%)	79 (23.9%) ^{c,d} 172 (52.1%) 65 (19.7%) 11 (3.3%) 3 (0.9%)	27 (33.3%) 33 (40.7%) 12 (14.8%) 8 (9.9%) 1 (1.2%)	9 (34.6%) 6 (23.1%) 11 (42.3%) 0 (0.0%) 0 (0.0%)	12 (24.5%) ^{a,c} 9 (18.4%) 12 (24.5%) 11 (22.4%) 5 (10.2%)	32 (21.1%) ^{b,d} 48 (31.6%) 42 (27.6%) 28 (18.4%) 2 (1.3%)	R (w = 0.335)
<ul style="list-style-type: none"> ● Refusal to treat - Very important - Important - Variable importance - Not very important - Not important 	339 (33.4%) 326 (32.1%) 232 (22.9%) 105 (10.3%) 13 (1.3%)	144 (38.3%) ^{a,b} 121 (32.2%) 74 (19.7%) 35 (9.3%) 2 (0.5%)	119 (36.1%) ^{c,d} 121 (36.7%) 66 (20.0%) 21 (6.4%) 3 (0.9%)	22 (27.2%) 24 (29.6%) 25 (30.9%) 9 (11.1%) 1 (1.2%)	8 (30.8%) 8 (30.8%) 5 (19.2%) 3 (11.5%) 2 (7.7%)	4 (8.2%) ^{a,c} 19 (38.8%) 17 (34.7%) 8 (16.3%) 1 (2.0%)	42 (27.6%) ^{b,d} 33 (21.7%) 45 (29.6%) 28 (18.4%) 4 (2.6%)	R (w = 0.252)
<ul style="list-style-type: none"> ● Treatment by non-qualified persons - Very important - Important - Variable importance - Not very important - Not important 	421 (41.5%) 281 (27.7%) 180 (17.7%) 104 (10.2%) 29 (2.9%)	164 (43.6%) ^a 111 (29.5%) 62 (16.5%) 29 (7.7%) 10 (2.7%)	152 (46.1%) ^b 99 (30.0%) 48 (14.5%) 22 (6.7%) 9 (2.7%)	33 (40.7%) 15 (18.5%) 18 (22.2%) 11 (13.6%) 4 (4.9%)	14 (53.8%) 5 (19.2%) 4 (15.4%) 2 (7.7%) 1 (3.8%)	17 (34.7%) 18 (36.7%) 9 (18.4%) 5 (10.2%) 0 (0.0%)	41 (27.0%) ^{a,b} 33 (21.7%) 39 (25.7%) 34 (22.4%) 5 (3.3%)	R (w = 0.243)

(Continued)

Table 3. (Continued).

Welfare issues <i>Likert-scale category</i>	Overall (1015) ²	Geographic region						Significance ⁴ /Effect size <i>w</i> ⁶
		Europe (376)	Asia (330)	North America (81)	South America (26)	Africa (49)	Oceania (152)	
● Convenience euthanasia								
- <i>Very important</i>	221 (21.8%)	60 (16.0%) ^{ab}	100 (30.3%) ^{a,c,d}	25 (30.9%) ^b	6 (23.1%)	5 (10.2%) ^c	25 (16.4%) ^d	R (w = 0.309)
- <i>Important</i>	307 (30.2%)	138 (36.7%)	95 (28.8%)	15 (18.5%)	10 (38.5%)	12 (24.5%)	37 (24.3%)	
- <i>Variable importance</i>	260 (25.6%)	103 (36.7%)	89 (27.0%)	14 (17.3%)	7 (26.9%)	13 (26.5%)	34 (22.4%)	
- <i>Not very important</i>	166 (16.4%)	57 (15.2%)	37 (11.2%)	19 (23.5%)	1 (3.8%)	8 (16.3%)	43 (28.3%)	
- <i>Not important</i>	61 (6.0%)	18 (4.8%)	9 (2.7%)	8 (9.9%)	2 (7.7%)	11 (22.4%)	13 (8.6%)	
● Uncontrolled or over-breeding								
- <i>Very important</i>	378 (37.2%)	149 (39.6%) ^a	130 (39.4%) ^b	31 (38.3%)	9 (34.6%)	21 (42.9%)	38 (25.0%) ^{a,b}	R (w = 0.214)
- <i>Important</i>	298 (29.4%)	118 (31.4%)	103 (31.2%)	23 (28.4%)	6 (23.1%)	10 (20.4%)	38 (25.0%)	
- <i>Variable importance</i>	178 (17.5%)	60 (16.0%)	54 (16.4%)	9 (11.1%)	7 (26.9%)	13 (26.5%)	35 (23.0%)	
- <i>Not very important</i>	116 (11.4%)	39 (10.4%)	34 (10.3%)	11 (13.6%)	3 (11.5%)	2 (4.1%)	26 (17.1%)	
- <i>Not important</i>	45 (4.4%)	10 (2.7%)	9 (2.7%)	7 (8.6%)	1 (3.8%)	3 (6.1%)	15 (9.9%)	

¹This table is based on questions 6–9 of the questionnaire (see supplementary Appendix).

²Total number of respondents worldwide as well as per geographic region is given in parentheses.

³Results are presented as scores (number of respondents) with in parentheses the relative frequency (%).

⁴Significance ($P < 0.002561$) based on the Likelihood ratio test (G-test of goodness-of-fit). R indicates significant difference between geographical regions.

⁵Contrast significance (*post hoc* comparisons, $P < 0.000171$). *Post hoc* testing was done by the Likelihood ratio test (G-test of goodness-of-fit). Within the same row (i.e. subject) values with the same superscript lowercase letter were significantly different.

⁶Effect size *w* was derived from Cramer's *V*. Small effects are indicated in *italics* and moderate effects in **bold**.

small effect, $w = 0.258$) and Oceania ($P < 0.0000005$; *small* effect, $w = 0.257$). In Oceania when compared with Europe ($P = 0.000087$, *small* effect, $w = 0.223$) or Asia ($P < 0.0000005$, *small* effect, $w = 0.297$) confinement/lack of exercise was considered less important. This also holds for Africa when compared with Europe ($P = 0.000004$, *moderate* effect, $w = 0.313$) or Asia ($P < 0.0000005$, *moderate* effect, $w = 0.381$), although the effects are now larger (Figure 1, panel E). Convenience euthanasia (Figure 1, panel F) was considered more of a welfare issue in Asia ($P = 0.000103$; *small* effect, $w = 0.182$) and North America ($P = 0.000152$; *small* effect, $w = 0.224$) than in Europe, and significantly more of a problem in Asia than in Africa ($P = 0.000008$; *moderate* effect, $w = 0.320$) and Oceania ($P < 0.0000005$; *small* effect, $w = 0.271$).

Top three welfare issues

The participants were asked to mention their top three welfare problems (Table 4). While most problems were scored 10% or lower, obesity (16%) and age-related problems (17%) had higher scores in Oceania. However, there were regional differences – for example, in South America treatment by non-qualified personnel was the most important issue, whereas in Africa the lack of routine prophylaxis was highest ranked concern.

Other welfare-related issues

Of the 1015 respondents, 140 made use of the open question about welfare issues. The most frequently mentioned topics were pet owner financial constraints ($n = 34$), mistreatment ($n = 22$), abandonment ($n = 16$), and delayed treatment ($n = 11$). Eleven other causes for diminished animal welfare were reported by fewer than 10 respondents.

Age and animal welfare issues

Worldwide there were only *weak* correlations between respondent age and opinions about the animal welfare issues (Table 5). The highest correlation was between age and refusal to treat ($R_S = 0.275$, $P < 0.0000005$, $n = 1015$). Except for age-related issues and separation-related behavior, the Spearman coefficients of rank correlation were positive.

When the correlations were investigated per geographic region (Table 5), South America showed the highest correlation. For this region there were *moderate* correlations between respondent age and refusal to treat ($R_S = 0.611$, $P = 0.000911$, $n = 26$), as well as between age and convenience euthanasia ($R_S = 0.570$, $P = 0.002374$, $n = 26$). Significant *moderate* correlation were also found for Oceania between age and animal abuse ($R_S = 0.346$, $P = 0.000911$, $n = 152$) and age and refusal to treat ($R_S = 0.330$, $P = 0.000033$, $n = 152$).

Gender-related differences in welfare issues

Gender differences in animal welfare issues were statistically analyzed global and per geographic region. Effect sizes and P values for the gender differences are summarized in supplementary Table S1. Worldwide male and female respondents had different opinions regarding genetic or breed-related issues ($P = 0.000030$; *small* effect, $w = 0.161$), obesity ($P = 0.000028$; *small* effect, $w = 0.161$), and uncontrolled breeding or over-breeding ($P = 0.000286$; *small* effect, $w = 0.145$). Globally female veterinarians considered these three aspects to be more of a welfare issue than did their male counterparts (Figure 2, panels A, B and F). In Europe female respondents when compared with males considered obesity to more of a welfare issue ($P = 0.000065$; *small* effect, $w = 0.259$) (Figure 2, Panel B). Further, in Oceania male and female respondents had different opinions regarding delay or refusal to euthanize ($P = 0.001060$; *moderate* effect, $w = 0.349$), animal abuse ($P = 0.000408$; *moderate* effect, $w = 0.360$) and refusal to treat ($P = 0.000696$; *moderate* effect, $w = 0.351$).

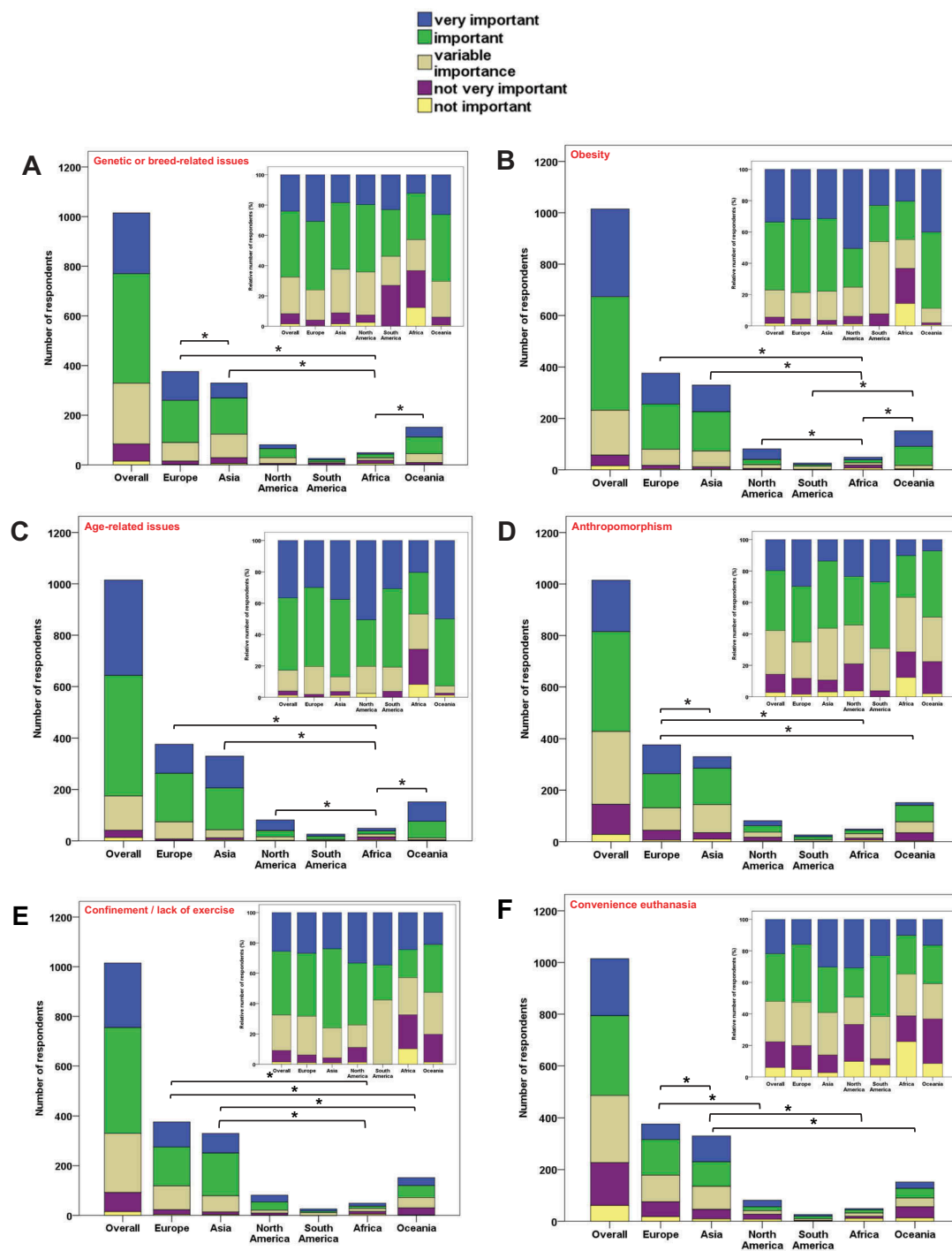


Figure 1. Views of veterinary practitioners and associated professions on animal welfare between the geographic regions of Europe, Asia, North America, South America, Africa and Oceania, as well as worldwide. In the main diagram results are presented as scores (number of respondents), whereas in the inserted diagram results are shown as relative scores (%). * = Significant difference ($P < 0.000171$) in *post hoc* comparison.

Table 4. The top three most important animal welfare issues: worldwide and per geographic region.^a

Welfare issues	Overall	Geographic region					
		Europe	Asia	North America	South America	Africa	Oceania
● Incorrect or inappropriate nutrition	200 (6.6%) ^b	92 (8.2%)	63 (6.4%)	10 (4.2%)	4 (5.1%)	10 (6.8%)	21 (4.6%)
● Genetic or breed-related issues	214 (7.1%)	120 (10.7%)	37 (3.7%)	8 (3.3%)	4 (5.1%)	7 (4.8%)	38 (8.4%)
● Lack of routine prophylaxis	249 (8.2%)	89 (7.9%)	83 (8.4%)	20 (8.3%)	8 (10.3%)	22 (15.0%)	27 (5.9%)
● Obesity	295 (9.7%) ^c	98 (8.8%)	82 (8.3%)	31 (12.9%)	5 (6.4%)	7 (4.8%)	71 (15.6%)
● Age-related issues	277 (9.1%)	83 (7.4%)	80 (8.1%)	23 (9.6%)	4 (5.1%)	8 (5.4%)	79 (17.4%)
● Aggression	69 (2.3%)	22 (2.0%)	18 (1.8%)	9 (3.8%)	5 (6.4%)	4 (2.7%)	11 (2.4%)
● Separation-related behavior	91 (3.0%)	13 (1.2%)	30 (3.0%)	10 (4.2%)	3 (3.8%)	3 (2.0%)	32 (7.0%)
● Lack of socialization	119 (3.9%)	33 (2.9%)	33 (3.3%)	17 (7.1%)	2 (2.6%)	5 (3.4%)	29 (6.4%)
● Disobedience	18 (0.6%)	4 (0.4%)	9 (0.9%)	0 (0.0%)	1 (1.3%)	1 (0.7%)	3 (0.7%)
● Inappropriate elimination	25 (0.8%)	6 (0.5%)	9 (0.9%)	6 (2.5%)	1 (1.3%)	0 (0.0%)	3 (0.7%)
● Delay or refusal to euthanize	94 (3.1%)	25 (2.2%)	39 (4.0%)	9 (3.8%)	3 (3.8%)	1 (0.7%)	17 (3.7%)
● Lack of knowledge	298 (9.8%)	113 (10.1%)	99 (10.0%)	28 (11.7%)	8 (10.3%)	21 (14.3%)	29 (6.4%)
● Animal abuse	121 (4.0%)	22 (2.0%)	68 (6.9%)	11 (4.6%)	1 (1.3%)	11 (7.5%)	8 (1.8%)
● Noncompliance	143 (4.7%)	46 (4.1%)	69 (7.0%)	9 (3.8%)	0 (0.0%)	3 (2.0%)	16 (3.5%)
● Anthropomorphism	74 (2.4%)	45 (4.0%)	13 (1.3%)	1 (0.4%)	8 (10.3%)	1 (0.7%)	6 (1.3%)
● Confinement/lack of exercise	75 (2.5%)	26 (2.3%)	23 (2.3%)	4 (1.7%)	3 (3.8%)	5 (3.4%)	14 (3.1%)
● Refusal to treat	240 (7.9%)	114 (10.1%)	91 (9.2%)	10 (4.2%)	4 (5.1%)	4 (2.7%)	17 (3.7%)
● Treatment by non-qualified persons	239 (7.9%)	108 (9.6%)	72 (7.3%)	16 (6.7%)	10 (12.8%)	18 (12.2%)	15 (3.3%)
● Convenience euthanasia	40 (1.3%)	15 (1.3%)	15 (1.5%)	3 (1.3%)	2 (2.6%)	2 (1.4%)	3 (0.7%)
● Uncontrolled or over-breeding	149 (4.9%)	49 (4.4%)	54 (5.5%)	15 (6.3%)	2 (2.6%)	14 (9.5%)	15 (3.3%)
Total	3030 (100%)	1123 (100%)	987 (100%)	240 (100%)	78 (100%)	147 (100%)	454 (100%)

^aThis table is based on questions 6–9 of the questionnaire (see supplementary Appendix).

^bResults are presented as number of votes with in parentheses the relative frequency (%).

^cThe three most important animal welfare issues are indicated in **bolditalics**.

Table 5. Association (Spearman's R_s) between age and attitude to animal welfare problems^a: worldwide and per geographic region.

Welfare issues	Overall (1015) ^b	Geographic region					
		Europe (376)	Asia (330)	North America (81)	South America (26)	Africa (49)	Oceania (152)
Spearman's R_s^c (P value^d)							
• Incorrect or inappropriate nutrition	0.108 (0.001)	0.146 (0.004)	0.095 (0.083)	0.087 (0.442)	0.438 (0.025)	−0.209 (0.149)	0.097 (0.234)
• Genetic or breed-related issues	0.138 (0.000)	0.070 (0.178)	0.051 (0.359)	0.120 (0.287)	0.142 (0.488)	0.162 (0.266)	0.120 (0.142)
• Lack of routine prophylaxis	0.060 (0.057)	0.027 (0.604)	0.159 (0.004)	0.148 (0.189)	0.376 (0.058)	−0.046 (0.753)	0.129 (0.114)
• Obesity	0.035 (0.266)	0.033 (0.526)	−0.024 (0.661)	0.042 (0.707)	0.531 (0.005)	0.211 (0.146)	0.005 (0.949)
• Age-related issues	−0.046 (0.147)	−0.096 (0.062)	0.095 (0.085)	−0.028 (0.802)	0.112 (0.587)	0.113 (0.438)	0.037 (0.650)
• Aggression	0.024 (0.437)	0.001 (0.985)	0.072 (0.193)	0.131 (0.243)	0.392 (0.047)	−0.036 (0.807)	0.156 (0.055)
• Separation-related behavior	−0.080 (0.010)	−0.063 (0.222)	−0.013 (0.821)	0.128 (0.255)	0.437 (0.025)	−0.173 (0.234)	0.101 (0.217)
• Lack of socialization	0.019 (0.552)	−0.014 (0.792)	0.076 (0.169)	0.291 (0.008)	0.428 (0.029)	−0.055 (0.706)	0.149 (0.067)
• Disobedience	0.053 (0.094)	0.069 (0.184)	−0.024 (0.660)	0.089 (0.432)	0.409 (0.038)	−0.111 (0.447)	0.038 (0.645)
• Inappropriate elimination	0.037 (0.234)	0.107 (0.039)	−0.007 (0.899)	0.090 (0.426)	0.306 (0.129)	−0.191 (0.188)	0.085 (0.296)
• Delay or refusal to euthanize	0.135 (0.000)	0.175 (0.001)	0.007 (0.895)	0.248 (0.026)	0.230 (0.257)	−0.041 (0.778)	0.218 (0.007)
• Lack of knowledge	0.068 (0.030)	0.027 (0.600)	0.057 (0.305)	0.226 (0.043)	0.473 (0.015)	−0.085 (0.562)	0.014 (0.864)
• Animal abuse	0.166 (0.000)	0.175 (0.001)	0.156 (0.004)	0.161 (0.150)	0.477 (0.014)	−0.302 (0.035)	0.346 (0.000)
• Noncompliance	0.140 (0.000)	0.134 (0.009)	0.091 (0.098)	0.245 (0.027)	0.182 (0.373)	0.133 (0.364)	0.183 (0.024)
• Anthropomorphism	0.095 (0.002)	0.040 (0.442)	0.002 (0.972)	0.189 (0.092)	−0.127 (0.536)	0.001 (0.996)	−0.039 (0.636)
• Confinement/lack of exercise	0.048 (0.126)	−0.022 (0.664)	−0.054 (0.328)	0.128 (0.256)	0.269 (0.183)	−0.023 (0.874)	0.093 (0.254)
• Refusal to treat	0.275 (0.000)	0.273 (0.000)	0.126 (0.022)	0.206 (0.065)	0.611 (0.001)	−0.066 (0.655)	0.330 (0.000)
• Treatment by non-qualified persons	0.180 (0.000)	0.135 (0.009)	0.112 (0.042)	0.246 (0.027)	0.485 (0.012)	−0.044 (0.766)	0.183 (0.024)
• Convenience euthanasia	0.175 (0.000)	0.174 (0.001)	0.081 (0.143)	0.182 (0.105)	0.570 (0.002)	0.095 (0.518)	0.242 (0.003)
• Uncontrolled or over-breeding	0.206 (0.000)	0.217 (0.000)	0.125 (0.023)	0.085 (0.450)	0.380 (0.056)	−0.063 (0.667)	0.268 (0.001)

^aThis table is based on questions 6–9 of the questionnaire (see supplementary Appendix).

^bTotal number of respondents worldwide as well as per geographic region is given in parentheses.

^cWeak correlations are indicated in normal fonts and moderate correlations in *italics*.

^dP value of Spearman's correlation test (two-tailed test based on the *t* statistic) is given in parentheses. Significant associations ($P < 0.002561$) are indicated in **bold**.

Oceanic male respondents considered these three items to be less of a welfare issue than did their female counterparts (Figure 2, panels C, D and E). There were no significant ($P > 0.002561$) gender differences for the remaining fourteen welfare issues; neither worldwide nor in the various geographic regions (supplementary Figure S2, panels A–N).

Educational background

In total 1052 surveys were returned on which the respondents indicated their educational background. There were 201 different universities, institutes, academies, colleges and schools awarding veterinary and allied degrees; these were located in 61 different countries (supplementary Table S2). Almost 75% of the institutions (151/201) consisted of one ($n = 81$), two ($n = 41$) or three respondents ($n = 29$). There were five institutions with > 40 respondents: Hebrew University of Jerusalem – Koret School of Veterinary Medicine ($n = 92$), Saint Petersburg State Academy of Veterinary Medicine ($n = 81$), Utrecht University – Faculty of Veterinary Medicine ($n = 66$), University of Sydney – Faculty of Veterinary Science ($n = 48$), and Moscow State Academy of Veterinary Medicine and Biotechnology ($n = 43$).

These five institutions were compared for the twenty animal welfare issues. The number of respondents that fill in the twenty questions were as follow: Hebrew University of Jerusalem – Koret School of Veterinary Medicine ($n = 77$), Saint Petersburg State Academy of Veterinary Medicine ($n = 73$), Utrecht University – Faculty of Veterinary Medicine ($n = 61$), University of Sydney – Faculty of Veterinary Science ($n = 44$), and Moscow State Academy of Veterinary Medicine and Biotechnology ($n = 40$). The results can be found in Figure 3 and in supplementary Figure S3 (panels A–S). For 10 welfare issues there were significant ($P < 0.002561$) differences between the five veterinary institutions (Figure 3, large effect: effect size $w = 0.524$; Figure S3, panels A, B, E, I, M, N, O, Q, R and S, moderate effects: effect size w ranged from 0.349 to 0.474).

Respondents that got their veterinary degree from the Utrecht University – Faculty of Veterinary Medicine considered treatment by non-qualified persons to be less of an animal welfare issue than those from Saint Petersburg State Academy of Veterinary Medicine ($P < 0.0000005$; large effect, $w = 0.651$) or from Moscow State Academy of Veterinary Medicine and Biotechnology ($P < 0.0000005$; large effect, $w = 0.559$) (Figure 3). Respondents that have their educational background in Saint Petersburg State Academy of Veterinary Medicine found this welfare issue more important than those from the Hebrew University of Jerusalem – Koret School of Veterinary Medicine ($P < 0.0000005$; moderate effect, $w = 0.452$) or from the University of Sydney – Faculty of Veterinary Medicine ($P = 0.000009$; moderate effect, $w = 0.466$) (Figure 3).

In Australia several institutions offer a veterinarian degree (supplementary Table S2), but the majority of the respondents have their origin at the University of Sydney – Faculty of Veterinary Science ($n = 48$), University of Melbourne – Faculty of Veterinary Science ($n = 40$), University of Queensland – School of Veterinary Science ($n = 39$) and Murdoch University – School of Veterinary and Biometrical Sciences ($n = 27$). These four Australian institutions were compared for the twenty animal welfare issues. There were no significant ($P > 0.002561$) differences for any of the welfare issues (results not shown).

Discussion

The aim of this study was to compare global veterinary attitudes and perceptions of animal welfare issues. Existing studies have compared the attitudes in various countries (Houpt et al., 2007; Voslářvá & Passantino, 2012). However, the global nature of this study did cause some problems. The 1015 respondents were not uniformly distributed over the six regions, with most countries having fewer than five respondents (Table 1). This make statistical comparisons between most countries underpowered and necessitated grouping countries by geographic region. However, some countries, namely, Russian Federation, Israel, and Australia, had more than a hundred respondents each,

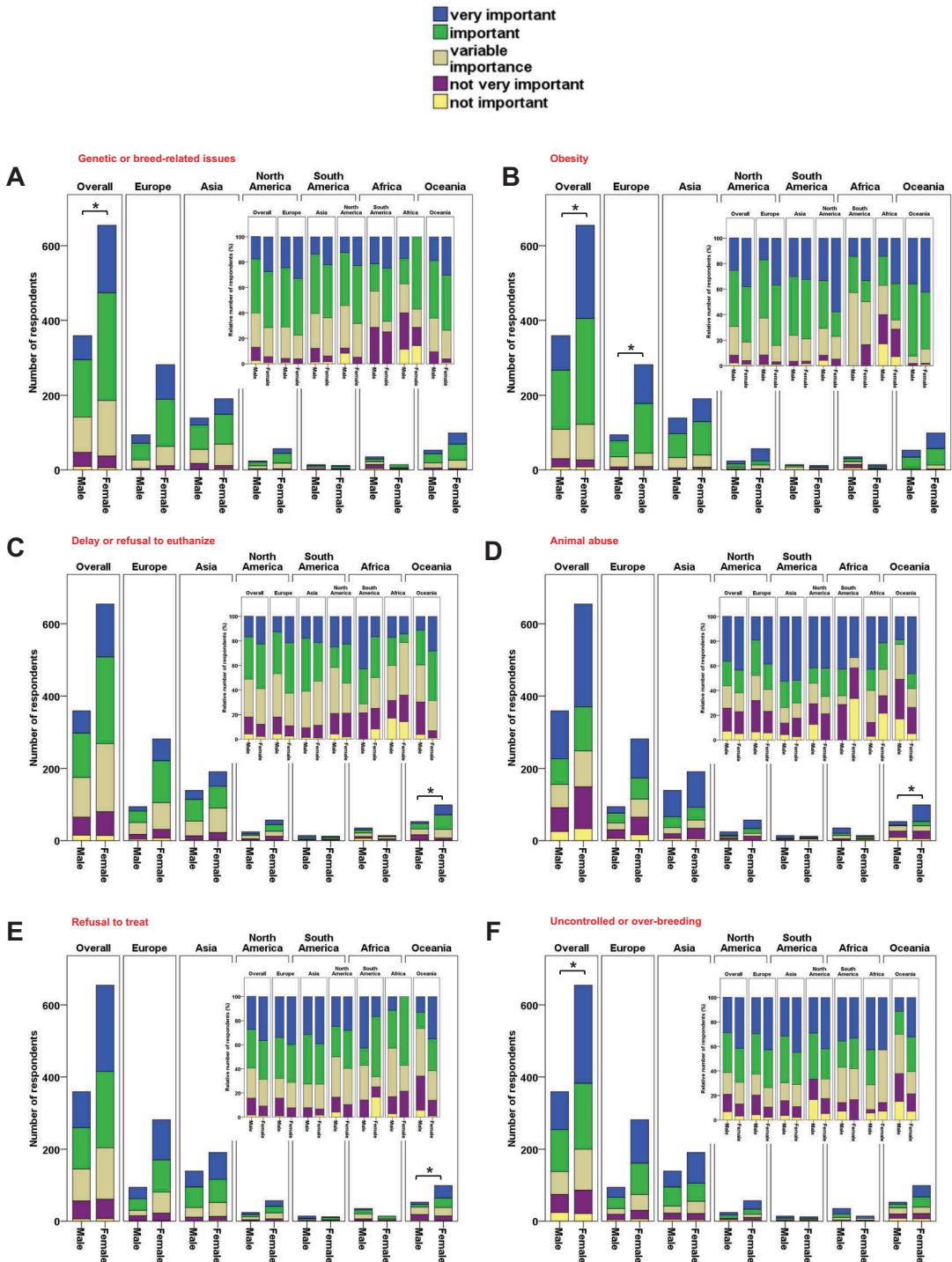


Figure 2. Views of male and female veterinary practitioners and associated professions on animal welfare between the geographic regions of Europe, Asia, North America, South America, Africa and Oceania, as well as worldwide. In the main diagram results are presented as scores (number of respondents), whereas in the inserted diagram results are shown as relative scores (%). * = Significant difference ($P < 0.002561$) in *post hoc* comparison.

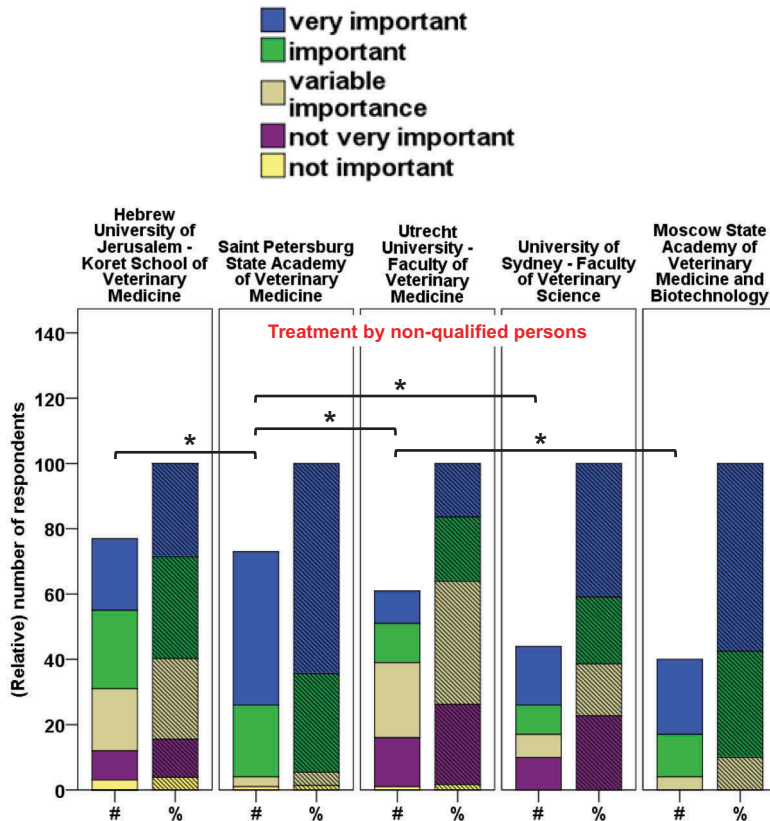


Figure 3. Views of veterinary practitioners and associated professions with different educational background. Per subdiagram (educational background) left and right bars represent scores (number of respondents) and relative scores (%), respectively. * = Significant difference ($P < 0.000256$) in *post hoc* comparison.

and thus had a substantial influence on the findings for their region. Another point is the wording of some of the questions. For instance, “*incorrect nutrition*” covers overfeeding, underfeeding, and inappropriate nutrition. These all affect welfare, but they are quite distinct. Combining these three topics gives valid, but generic data, as it is difficult to determine which of the three was considered most important in a region.

Veterinarians are usually low responders and veterinarians responding to animal welfare questionnaires are usually those with a special interest in welfare (Arhant, Hörschläger, & Troxler, 2019; Dawson, Dewey, Stone, Guerin, & Niel, 2016). This, however, can’t be prevented. Filling in a questionnaire is voluntary. But the results may not be representative for veterinarians with less interest in animal welfare (Arhant et al., 2019). The questionnaire was distributed electronically through the website of WSAVA and member organizations. Studies showed that electronic surveys achieve lower response rates and have higher percentages of item non-response compared with traditional paper surveys (Menachemi, 2011). However it was impossible to question veterinarians worldwide about animal welfare in any other way.

There were significant regional differences about the importance of many of the twenty welfare issues (Table 3, Figure 1 and supplementary Figure S1), which is not unexpected given the diversity of cultures, educational standards, and socioeconomic conditions. In another study where a comparison was made between animal welfare issues between Asia, the Far East and Oceania, it was found that there are significant regional differences. In Asia and the Far East cruelty has been largely prevented through the effort of animal welfare organizations, but that their efforts are far too

limited due to mainly financial constraints. While in New Zealand and Australia in contrast to the other Oceanic countries, governmental legislation regulates and improves animal welfare (Rahman, Walker, & Ricketts, 2005).

Obesity was considered an important welfare issue in most geographic regions, with the exception of South America and Africa (Figure 1, panel B). Excessive weight and obesity are becoming increasingly common in humans and their pets (German, 2006; Vis & Hylands, 2013) and are associated with the development of a number of diseases that reduce an animal's welfare and life span (Klinkenberg, Sallander, & Hedhammar, 2006). In contrast, anthropomorphism was apparently much more a first-world welfare issue, being significantly less of a concern in Asia, Africa, and Oceania (Figure 1, panel D). Opinions about convenience euthanasia differed significantly between Asia and Europe, Africa and Oceania (Figure 1, panel F). This may stem from cultural or possibly religious beliefs (e.g. Buddhists regard all life as sacred) (Bülow et al., 2008).

Confinement and lack of exercise was in Asia much more an issue than in Africa and Oceania (Figure 1, panel E). The reason for this is a bit unclear. Maybe the temperature, humidity or a lack of space could have influenced this. Genetic or breed-related issues were a significant bigger problem in Europe than in Asia, Africa and Oceania (Figure 1, panel A). Lately a lot of attention has been given to this sort of problems in Europe (FECVA, 2018). So there is probably more awareness and much more animals that suffer from these sort of problems. The topic of age-related issues was for the veterinarians in Africa significantly less a problem than in Europe, Asia, North America and Oceania (Figure 1, panel C). Maybe companion animals will not get that old in Africa because the level veterinary care owners can afford is lower (LaVallee, Kiely Mueller, & McCobb, 2017). Separation-related behavior is in North America more a problem than in Europe. The same is true for Oceania (supplementary Figure S1, panel D). It is difficult to explain these differences. It can be that in North America and Oceania companion animals are more attached to their owners and when left alone separation-related behavior is shown. But there is no scientific evidence that the level of attachment of animals between continents differ.

Respondents were asked to identify the top three animal welfare issues in their region (Table 4). Obesity, age-related issues and lack of knowledge were the most important welfare issues worldwide. It is of interest to note that obesity and age-related issues are associated to each other because they loaded high on the same component after performing a CATPCA (Table 2). Furthermore, these two welfare issues showed the highest effect size in the geographic region comparison (Table 3). In Europe, breed-related issues were regarded as most important, which was not unexpected as selective breeding has been practiced for decades (Sandøe et al., 2017) and has led to hereditary defects in many breeds (Farnworth, Chen, Packer, Caney, & Gunn-Moore, 2016; Packer, Hendricks, & Burn, 2012). This was very different in Africa, where such breeding practices are far less common. In some South American countries, there are less strict rules regarding the education of veterinarians and who may act in a veterinary capacity compared with, for example, North America (Edwards, 2004). This may explain why treatment by non-qualified persons was mentioned as a primary animal welfare concern.

Looking at welfare issues, geographic regions and gender, there are not many differences (Figure 2, supplementary Figure S2 and supplementary Table S1). Worldwide female veterinarians regarded genetic and breed-related health issues (Figure 2, panel A), obesity (Figure 2, panel B), uncontrolled breeding or over-breeding (Figure 2, panel F) to be more important as animal welfare issues than did their male counterparts. It has been observed that in general female veterinarians may be more empathic toward owners and animals (Christov-Moore et al., 2014; Hazel, Signal, & Taylor, 2011), although our results do not necessarily bear this out.

In Oceania there were the most significant gender differences on delay or refusal to euthanize (Figure 2, panel C), animal abuse (Figure 2, panel D) and refusal to treat (Figure 2, panel E). Oceanic females were of opinion that these issues were more important than males were. The reason for this is unclear and also why this was only the case in Oceania. In Europe females thought that obesity was more an welfare issue than males (Figure 2, panel B). Also here the reason why this was only the case in Europe remains unclear.

Although many correlations were weak, there were some significant correlations between age and animal welfare issues (Table 5). For most questions, older respondents age was directly correlated with fewer animal welfare issues reported. This may be greater awareness of animal welfare issues with changes in veterinary education over the last two decades (Broom, 2005), placing greater emphasis on animal welfare in the veterinary curricula nowadays.

Regarding educational background there were some significant differences between the four veterinary schools who had more than 40 former students (supplementary Table S2), and now veterinarians, answering the questionnaire (Figure 3 and supplementary Figure S3, panels A, B, M, N, O, Q and S). The one with the *large* effect size was on treatment by non-qualified persons (Figure 3). Especially the veterinarians who were educated in the two Russian Federation veterinary academies saw this as a major threat to animal welfare compared to the Hebrew University of Jerusalem (Koret School of Veterinary Medicine), Utrecht University (Faculty of Veterinary Medicine) and University of Sydney (Faculty of Veterinary Medicine). It could be that the regulations in the Russian Federation are different or because of the vastness of the country adequate veterinary care is not always available.

The top four of veterinary institutions regarding number of respondents in Australia (supplementary Table S2) were also compared. On the websites of these four veterinary schools it can be found that all four of them have animal welfare courses for undergraduate and graduate students, which might explain why there are no significant institutional differences regarding the twenty welfare issues.

While the twenty questions covered a broad spectrum of possible welfare issues, the survey also allowed respondents to mention additional subjects. Only a few respondents made use of this opportunity and the welfare issues mentioned were not dissimilar to those covered by the survey proper. One issue affecting animal welfare was, in various guises, referred to several times – namely, owner finances. Animal owners may want to provide for their pets, but not be able to afford all veterinary services. Thus, financial considerations may negatively impact on many of the welfare issues referred to in the survey.

Conclusions

This is the first global comparison of the opinion of companion animal veterinarians on various animal welfare issues. Pet obesity can be considered a global problem. Appropriate nutrition is a topic that appears to require additional attention at educational, practice, and societal levels. Although more a first-world problem, anthropomorphism influences how owners interact at their pets and how they feed them. Owners often use food or treats to strengthen the human–animal bond, often without considering the detrimental effect this might have on their pet's health. The strong bond between owner and pet may make it difficult to make logical, unemotional judgments, which may delay euthanasia and thus adversely affect their pet's welfare. Conversely, owners may resort to euthanasia to replace or rid themselves of a pet rather than inconvenience themselves socially or financially. Euthanasia of a healthy animal performed for these reasons can be morally, ethically, and emotionally troubling for the attending veterinarian (Yeates, 2010). Lastly, not all owners are aware of the costs of maintaining a companion animal, such as the costs of appropriate nutrition, medical bills incurred, grooming needs, time needs for physical and emotional enrichment, and preventive care, just to name a few.

Note

1. Companion animals can be defined as “domesticated or domestic-bred animals whose physical, emotional, behavioural and social needs can be readily met as companions in the home, or in close daily relationship with humans” (ASPCA, 2018). While this definition can encompass many species of animals, this document primarily refers to the welfare of dogs and cats.

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